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(71) Applicant: THE GOODYEAR TIRE & RUBBER COMPANY
1144 East Market Street
Akron, Ohio 44316-0001(US)

(72) Inventor: Croyle, Warren Lee
4360 Copley Road
Akron, Ohio 44321(US)
Inventor: Brayer, Randall Raymond
1424 Saddle Street, N.E.
Uniontown, Ohio 44685(US)

(74) Representative: Leitz, Paul
Goodyear Technical Center-Luxembourg
L-7750 Colmar-Berg(LU)

(54) A tread for a tire.

(57) An asymmetric directional tread (12) for a tire (10) is disclosed. The tread (12) has a plurality of ground engaging tread elements (50) separated by grooves (15, 17A, 17B, 18, 19). The grooves include one wide circumferentially continuous groove (18) having a width W, a plurality of circumferentially continuous grooves (15) of an intermediate width between 1/3 and 3/4 W, at least one narrow circumferentially continuous groove (19) having a width 1/10 to 1/3 W located between a lateral edge (14) and a circumferentially continuous groove of a greater width, and first and second sets of laterally extending grooves (17A), the first set (17A) extends from the outboard lateral edge (14) to within 5% of the equatorial plane (EP). The second set (17B) extends from the inboard lateral edge (16) to within 5% of the equatorial plane (EP).

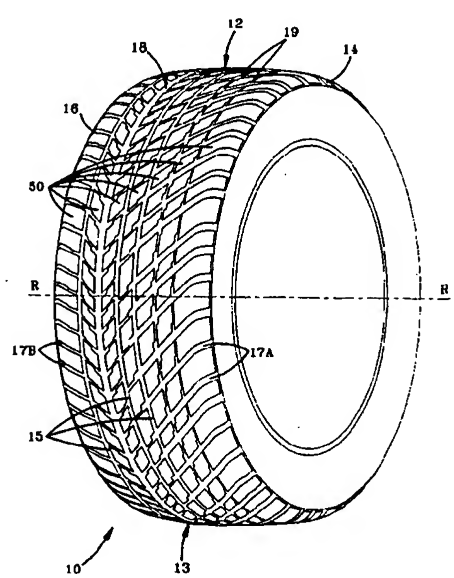

FIG-1

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is a groove having a width in the range from about 0.2% to 0.3% of the compensated tread width, whereas a wide groove has a width (W) greater than 2% of the compensated tread width, an intermediate width groove has a width 1/3 to 3/4 W, and a narrow groove has a width of 1/10 to 1/3 W. The "groove width" is equal to tread surface area occupied by a groove or groove portion, the width of which is in question, divided by the length of such groove or groove portion; thus, the groove width is its average width over its length. Grooves, as well as other voids, reduce the stiffness of the tread regions in which they are located. Slots often are used for this purpose, as are laterally extending narrow or wide grooves. Grooves may be of varying depths in a tire. The depth of a groove may vary around the circumference of the tread, or the depth of one groove may be constant but vary from the depth of another groove in the tire. If such narrow or wide grooves are of substantially reduced depth as compared to wide circumferential grooves which they interconnect, they are regarded as forming "tie bars" tending to maintain a rib-like character in the tread region involved.

"Sipe" means small slots molded into the tread elements of a tire that subdivided the tread surface and improves tractions.

"Inside Shoulder" as used herein means the shoulder nearest the vehicle.

"Outside Shoulder" as used herein means the shoulder farthest away from the vehicle.

"Rib" means a circumferentially extending strip of rubber on the tread which is defined by at least one circumferential groove and either a second such groove or a lateral edge, the strip being laterally undivided by full-depth grooves.

"Tread Element" means a rib or a block element.

"Equatorial plane (EP)" means the plane perpendicular to the tire's axis of rotation and passing through the center of its tread.

Brief Description of the Drawings

Fig. 1 is a perspective view of a tread according to the present invention annularly attached to a tire.

Fig. 2 is a plan view of the tread illustrated in Fig. 1.

Fig 3 is a view illustrating the footprints of the tire in the four wheel positions of a vehicle.

Fig. 4 is a view illustrating the footprints of the tire in the four wheel positions of Fig. 3 subjected to a turn or cornering maneuver.

Detailed Description of the Invention

With reference to Fig. 1, a tread 12 according to the present invention is illustrated. The tread 12 is annularly attached to a tire 10. The tread 12 as illustrated, is asymmetric and directional.

An asymmetric tread has a tread pattern that is not symmetrical about the centerplane or equatorial plane of the tire.

A directional tread is a tread that has a preferred direction of forward travel and must be positioned on a vehicle to insure that the tread pattern is aligned with the preferred direction of travel.

The use of directional tread patterns enables the tread to be optimized for forward travel. Conventional non-directional tires are designed such that the tire can be mounted without a preferred direction of travel. This means that the tread must perform equally well regardless of how the tread is mounted to the tire. For this reason non-directional tire treads are generally designed specifically to give uniform performance in either direction of travel. The non-directional feature is an additional design constraint that forces design compromises that limit the performance capability of the tire.

The conventional passenger tire also has a tread pattern that is symmetrical relative to the centerplane of the tread. This enables the tire to freely be mounted independent of the direction of travel on either side of the vehicle. This symmetry of design assumes that the design loads and requirements must be equally met regardless of the tire orientation.

The use of an asymmetric tire with a directional tread means that there are left side and right side tires. This enables the tire designer to optimize the tread design to accommodate the vehicle requirements. The axial or lateral extent of the tread design can be varied to enhance performance.

The tread 12 illustrated in Figs. 1 and 2 is one example of an asymmetric-directional design according to the present invention.

The tread when configured annularly has an axis of rotation R, inboard and outboard lateral edges 16, 14 respectively, and a central portion 13 therebetween.

The tread has a plurality of ground engaging tread elements 50 separated by grooves. The grooves are uniquely configured relative to each other thereby creating a tread pattern that has excellent traction

outboard region provides good tread wear and dry traction while the inboard region insures good wet and snow traction. The combination of the two regions enables the tire tread 12 to achieve excellent performance capabilities.

Figures 3 and 4 illustrate a set of tires having treads according to the present invention. The tires are aligned according to the preferred direction and asymmetrically orientations. In Fig. 3 the shaded areas represents the footprints of each tire in a forward straight line direction of travel. In Fig. 4 the shaded areas represent the theoretical effective footprints of the tires in a hard turning maneuver. As can be seen the outboard set of tires have a larger effective footprint than the inboard tires. The outboard tires absorbing the majority of the vehicles weight as the car turns.

As illustrated in Fig. 3, the combination of lateral grooves and circumferential grooves in the footprint or contact patch of the tire represents almost all of the water evacuation capacity of the tire, absent some limited amount absorbed by siping. By using narrow grooves near the outer lateral edge it is estimated that the tread water evacuating capacity in a hard cornering maneuver is reduced by less than 5% when the narrow groove void is occupied by the flexing outboard tread elements. Correspondingly the increased stiffness that results actually improves the overall traction in fast wet turns.

Additionally as the tire turns the intermediate width lateral groove on the outboard set of tires angularly moves to alignment with the direction of vehicle travel. The wide lateral grooves as illustrated, facilitates water channeling through the grooves in hard turning maneuvers. This reduces the potential for hydroplaning in such turns.

The tire of the present invention can be produced with undercut or negative angle trailing edge surfaces at the tread elements adjacent to the lateral edges. A co-pending patent application serial number 07/736,189 describes in detail this design concept.

Also, the tread may have circumferential groove walls with variations in the angular orientation of the walls as a function of axial distance from the first or outboard lateral edge. A detailed description of such angular variations is described in co-pending patent application serial number 07/736,182.

Also, the tread as illustrated may employ two independent angularly oriented pitches. The pitches being different in number and length are described in detail in co-pending patent application serial number 07/736,192.

The tread may also be manufactured with crowned tread elements as described in U. S. Patent No. 4,722,738.

Each of the teachings described above are incorporated herein by reference.

Experimental tests under a variety of conditions were conducted with tires made according to the present invention. As a control commercially available tires of the same size designation as the test tires was utilized. Comparison of the tires were made under identical test conditions. To insure comparative results the same vehicle was used for each particular trial.

The tread according to the present invention was tested in two versions. One version included the crowned tread elements and the variation in circumferential groove angles. A second test version did not have those two features but was identical to the first test version tires in all other respects. As a control, test versions of the tire according to the present invention were compared to a Goodyear Eagle® ZR50 high performance tire.

All tires tested were of a P245/50ZR16 size designation. The treads were attached to a radial ply tire comprising a pair of annular beads; a carcass, including two radial plies oppositely angled at 85° relative to the equatorial plane of the tire, a liner, a pair of apexes; a belt and an overlay both positioned between the carcass and the tread; a pair of sidewall extending from the bead regions to the tread along the outer surface of the carcass.

The test and control tires were similarly constructed, however the test tire utilized a different tread compound than the control tire. This insured that the comparison was fundamentally a function of the tread design differences.

A summary of the test results revealed the following:

1.) The test tires performed the same or better than the control tires in every test but a force & moment test and a dry handling subjective test.

2.) The conventional tread element test tire performed better than the crowned element test tire in terms of noise, and was also slightly faster.

3.) The overall high speed performance of both test tires was improved over the control tire.

4.) The crown elements test tires were superior in terms of hydroplaning.

The following table illustrates the test results. The raw data is normalized with the control tire being the standard.

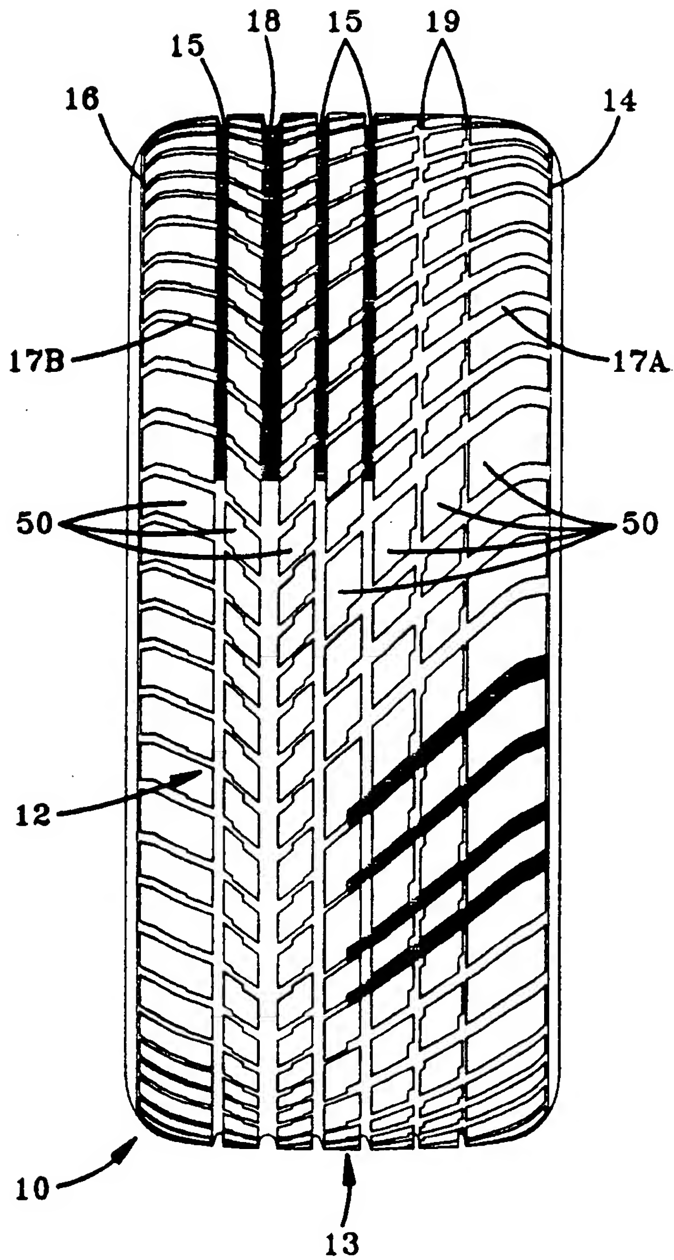
angular orientation of the first set of lateral grooves between the wide circumferential groove and an intermediate width circumferential groove.

5. The tread of claim 4 wherein the first and second set of lateral grooves terminate at an intermediate width groove of the tread.

6. The tread of claim 1, wherein the lateral grooves of the first set extend to and intersect the lateral grooves of the second set thereby forming a continuous groove path.

7. The tread of claim 1 wherein the lateral grooves of the first set have a width greater than the width of the second set of lateral grooves.

8. The tread of claim 7 wherein the width of the first set of lateral grooves is at least two times greater than the width of the second set of lateral grooves.



FIG–2

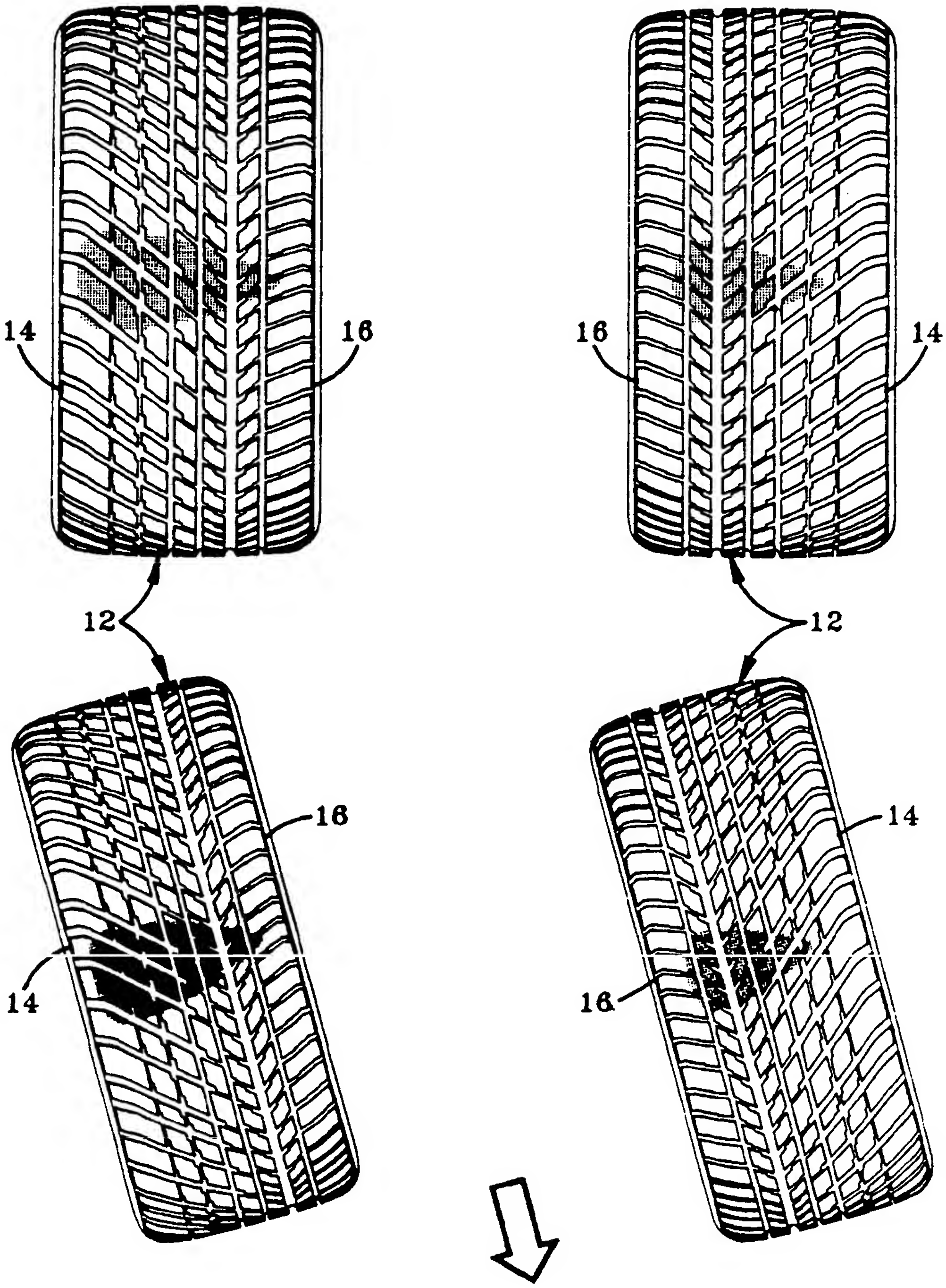


FIG-4